# Urban Planning and Biodiversity: Thoughts about an ecopolis, plea for a lobe-city. Case-study of the Belgian cities Sint-Niklaas and Aalst.

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**Abstract:** In 1994, Tjallingii [1] launched the ECOPOLIS-concept in an attempt to find answers for the environmental problems of urban design. In 1996 he developed his thoughts in a doctoral thesis at the Delft University of Technology [2], in which he made a plea for the "lobe-city" as the best urban model for an ecopolis. Indeed, the lobe-city offers good prospects to conserve urban biodiversity. The model was developed in the first half of the 20th century as an alternative for concentric growth which appeared to be suffocating citizens. By contrast, the lobe-city is characterised by blue-green fingers (i.e. carriers of water, biodiversity and countryside features) penetrating deep into the urban area, thus separating the densely built-up city lobes from each other.

This paper presents the application of the lobe-city model on two small sized Belgian cities: Sint-Niklaas (68.000 inhabitants) and Aalst (78.000 inhabitants). This paper shows that the objectives for both cities in terms of new dwellings and industrial areas can be achieved on less city surface, applying this lobe-city model in stead of using the classic concentric expansion. Moreover, urban biodiversity and an ecologically sound urban water management can benefit from the blue-green fingers. As a consequence, the lobe-city seems to be a key towards climate proof urban planning, for it's tempering the urban heat-island effect.

**Keywords:** climate proof urban planning, lobe-city, ecopolis, urban biodiversity, blue-green fingers.

## 1. INTRODUCTION

Cities are generally regarded as the cause of many ecological and social problems. Can they, in the future, also become the source of solutions? And if so, what are the best strategy and the best urban model for achieving these goals?

In literature, a discussion is going on for a long time about the best form of a sustainable city. Is a compact city the best shape for an ecopolis [3, 4, 5]? Well-known is the compact-city debate: how sustainable is compact and how compact is sustainable? Uncontrolled spreading of the city (urban sprawl) is harmful for rural areas and causes increasing mobility problems. But building in the scarce open green areas within the city to make the city more compact is not a good idea either. The residents lose green within walking-distance and moreover, the solution of the water problems of the city needs vast green infiltration areas very close to the impenetrable city centre.

## 2. THE LOBE-CITY AND THE GARDEN-CITY

### 2.1 The lobe-city

The lobe-city model (Fig. 1) was developed in the first half of the 20th century. To varying degrees, this model was used in Denmark for the "fingerplan" in Copenhagen (1948), the general plan to extend Amsterdam (1935) and in cities such as Hamburg, Köln (1927), Berlin (Germany) and Stockholm (Sweden). Also the planners developing Shangai Dongtan (China) as an eco-city, use the concept of blue-green fingers [6].

The lobe-city characteristically offers *blue-green wedges (= fingers)* between the built-up lobes. Those blue-green fingers should be connected with the ecological infrastructure in the rural area (Natura 2000)[1]. The blue-green fingers attract biodiversity next to the city centre and provide possibilities for storage and infiltrating of rainwater from the impervious city. Storing storm water in blue-green fingers close to the dwellings, can avoid flooding elsewhere. The blue-green fingers are attractive for residents to walk and cycle next door and they have a good influence on the urban climate, tempering the urban heat-island effect (www.epa.gov/heatisland) (Fig. 2). These blue-green wedges can be combined with some extensive urban functions such as graveyards, children's farm, gardening for citizens, urban agriculture, sport and leisure infrastructures, etc. When an appropriate pattern (gradients) is designed and an ecologically sound management process is applied, the biodiversity and the social values of those blue-green wedges might be huge [2].

Accepting a cycling-maximum of 15 minutes, the length of *the built-up city lobes* should be not longer than about 2500 meters. Tjallingii proposes 600 meters for the width of the lobes, in order to keep the green within walking distance from the residents. In order to set up a payable public transport system, dwellings in the city-lobes should be built compactly. Enough people should be living within a walking distance from bus or tram stops. The central axes of the city lobes offer very good and frequent public transport systems. Business areas are located also in lobes, next to railways and motorways. Thus a city lobe has a surface of 2500 x 600 m² which is around 150 ha. Following Tjallingii's proposal to build with a density of minimum 50 dwellings/ha (7500 dwellings in a city lobe), in a lobe-city up to 100.000 inhabitants can live. Further expansion of the city into rural areas, should be planned along the axes of public transport, densely around the railway stations, as a string of beads [7].

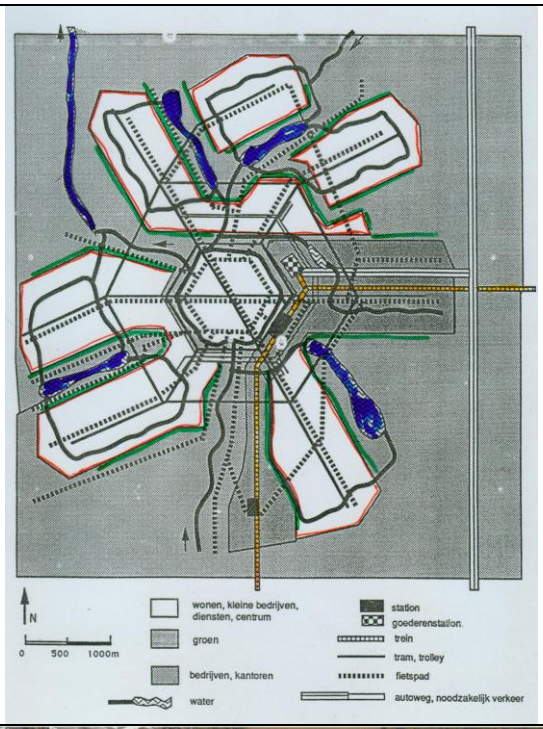
In a lobe-city the water-chain carries the blue-green fingers, the (public)traffic-chain carries the built-up lobes.

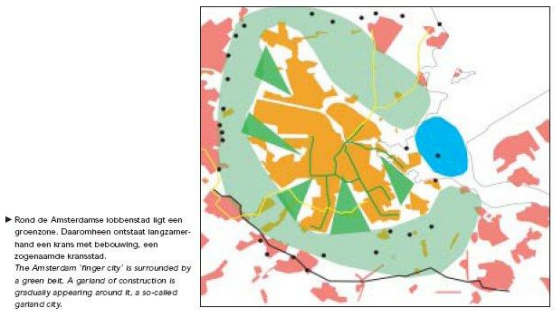
[1] The Natura 2000 network is based on two European directives: the birds directive (79/409/EEG) and the habitats directive (92/43/EEG), both aiming to preserve European biodiversity and forcing EU-member-states to plan a network of nature reserves crossing national boundaries, for conservation purposes http://ec.europa.eu/environment/nature/home.htm

[2] Of course there is a need for more research to investigate carefully whether blue-green wedges close to dwellings in tropical and subtropical regions always are safe in terms of wildlife. One can imagine citizens in southern Asia, Africa or southern America being anxious living too close to dangerous wildlife. The European situation is quite different, for dangerous animals for example are rarely living close to cities. Further social and biological research on this topic is needed.

With this urban model, Tjallingii shows the way out of the compact-city discussion. Citizens can benefit both: there are green areas next door as well as good public transport and the city centre (with the central railway station) is in cycling distance from the dwellings. The EU [8, 9] also advocates the lobe city, presenting the mobility component in the fingerplan of Copenhagen as a good example of sustainable urban planning. In EU (2003:23) we find: *Transport can be considered as a derived demand of the wish to perform activities and land-use describes the spatial distribution of activities. The linkage between land-use and transport is widely recognized and a growing number of cities are developing integrated land-use and transport plans. Good examples of integrated policies are the fingerplan-structure in Copenhagen (Denmark) and the integrated land-use, landscape and transport planning in the Greater region of Stuttgart (Germany).*

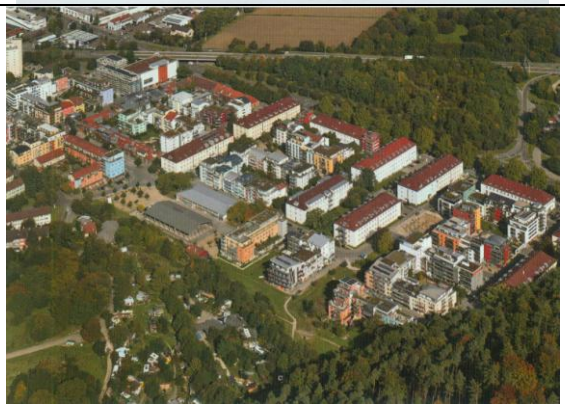
Indeed, both examples (Copenhagen and Stuttgart) are based on a lobe-city approach.




Top:
Amsterdam (NL) as a lobe-city example. Source: http://www.dro.amsterdam.nl/Docs/pdf/PLAN%201%202006.pdf

Left:
In a lobe-city, blue-green fingers are penetrating deep between built-up city lobes. Source [2].



Tübingen (Germany). Mixed use in he compact built-up city-lobe *French Quarter:* 240 inhabitants/ha and 50 to 60 labour places are created per ha. Blue-green fingers are nearby.

Tübingen (Germany). The urban fringe of the city-lobe *French Quarter*. (*picture by Erik Rombaut)*

**Fig. 1** A lobe-city is probably the best form for an ecopolis. In a lobe-city the water-chain carries the green fingers, the (public)traffic-chain carries the built-up lobes.

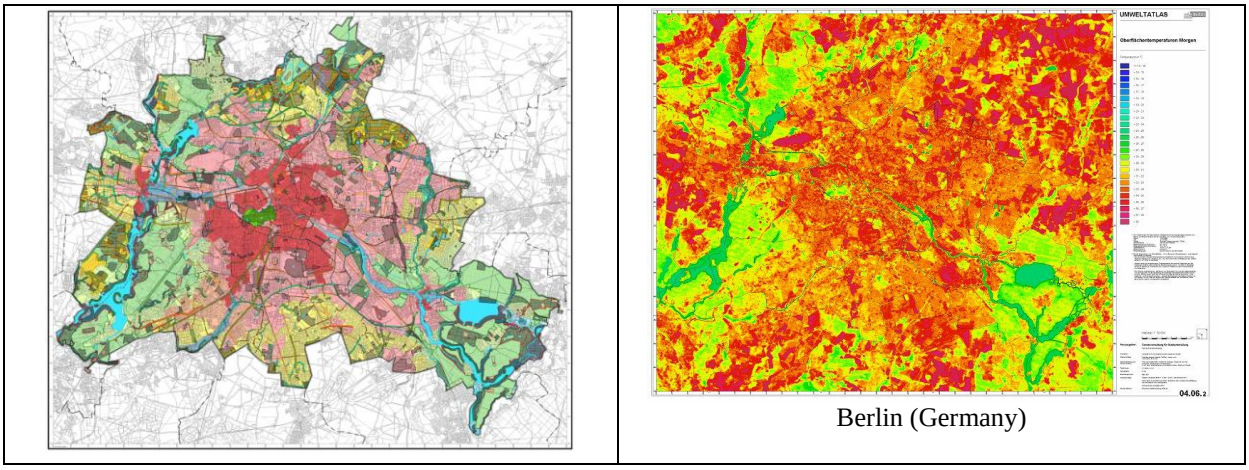



**Fig. 2** Blue-green fingers have an interesting impact on urban climate. The built-up areas have a higher temperature, thus a lower air pressure than blue-green areas. Blue-green fingers remain colder. Air transport from green areas towards the city keeps lobe-cities cooler and brings more humidity. The pictures show Berlin (Germany). On the left picture the blue-green areas are clearly visible. The infrared picture (right) shows he differences in temperature [10]. This is an illustration of the well-known urban heat-island effect: Concrete, bricks and paved tracks get warmer than blue-green areas [11].

### 2.2 The lobe-city versus the garden-city

In fact the lobe-city concept is another way to fill in the ideas of Ebenezer Howard, which were an answer on the social problems in industrial cities in the United Kingdom at the end of the 19th century. Howard [12] presented with his 'three magnets' theory a new concept: *the garden-city.* In that concept he liked to wed 'city' and 'country', by placing houses in 'yards'. The advantages of urban and rural areas were combined in so-called 'new-towns' [13]. Each lot has its own house surrounded by a private garden. The main critique on this large lot zoning in garden-cities is the lack of density, the main reason why public transport systems are due to fails and all other public services are very expensive. Scattered dwellings (urban sprawl) are difficult and expensive to connect to sewer systems, and to all kinds of public services. Garden-cities produce environmental and mobility problems.

In North America, the Broadacre City plans of Frank Lloyd Wright [14] - in which everyone could afford to have a house on an acre of land, and get there by car (or helicopter!) - were the seeds of an intellectual and aesthetic justification for urban sprawl [15]. Streets were designed in an endless grid. The gridiron layout (streets usually north-south, east-west oriented) was criticized by Fishmen [16], in his criticism on 'America's new city': *The grid is boundless by its very nature, capable of unlimited extension in all directions… it is destroying the freedom of movement and access to nature that were its original attraction… the 'new city' has an urban form that is too congested to be efficient, too chaotic to be beautiful and too dispersed to possess the diversity and vitality of a great city... no one can find the centre of a new city and its borders are even more elusive… in the old central cities, the jobless have moved in, the jobs have moved out…*

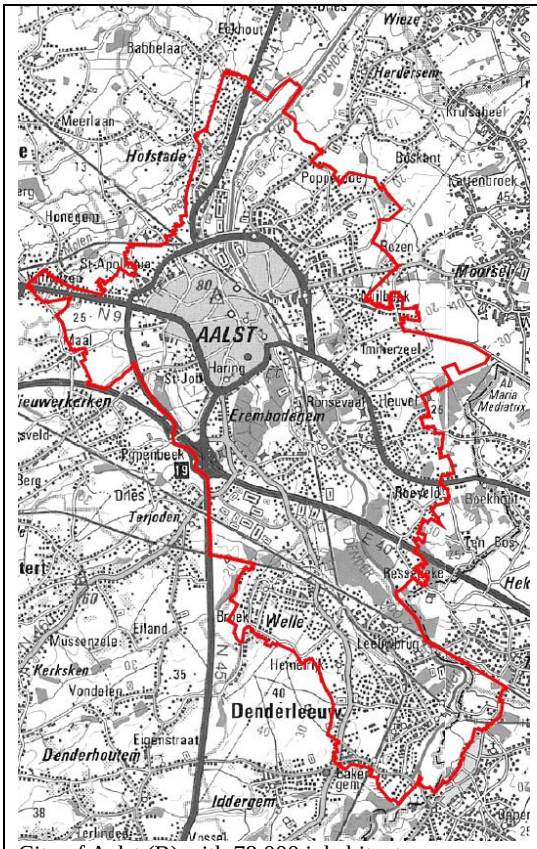
Uncontrolled expansion of broadacre cities ends with unliveable situations such as Los Angeles, a city of almost 100 km². A US-study [17] gathered data from all over the US and compared impact of density on schools, fire and police services, government facilities, roads and utilities. Up to 50 % less investment costs and up to 44% less energy costs were found in higher-density communities. Unfortunately, the American government did ignore the message, and now, decades later, the shape of cities in America and most of the rest of the world is worse than ever [15: 111-112]. Indeed, the situation in many European cities and regions is not better [18]. Suburbanisation of houses, and more recently of economic activities, has caused ribbon development (so-called 'roadscapes'), building in the outskirts and a spreading of building in the countryside in many European countries. The ribbon development has choked public bus transport in always bigger traffic jams. Moreover, the ribbons are too small; people do not live close enough to each other. Ribbons are not city-lobes, sensu-Tjallingii. So the only ecologically sound answer on this critique is to widen those ribbons towards built-up broader lobes, thus to build a lobe-city.

In a 'new city' the gardens surrounding each house mean a separation between neighbours. One can only meet the neighbours at the entrance of the yard, driving by car to the house. In garden-cities social loneliness is a real danger, neighbours are far away, the green is *insulating people from each other*. In contrast, lobe-cities combine urban and rural features very close to each other in a completely different way, as we explained earlier, the (semi)public blue-green fingers between the densely built-up lobes are *connecting people to each other*. Social benefits are guaranteed, if one can resist privatising them [19].

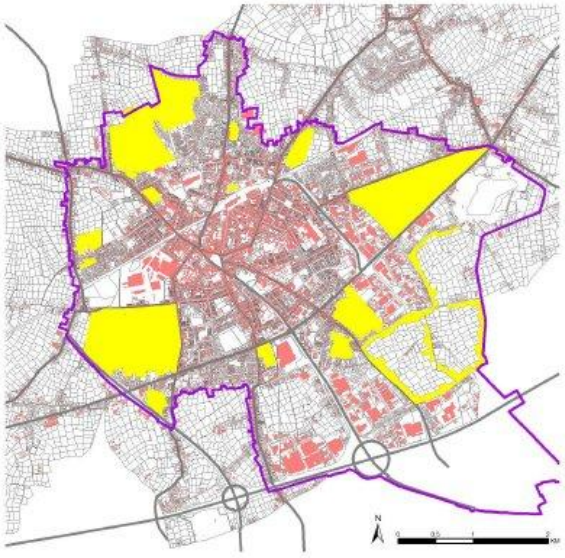
## 3. CASE STUDY BELGIAN CITIES *SINT-NIKLAAS* AND *AALST*

### 3.1 Problem: The concentric expansion of the compact city

The official plans of the planning authority for the city extension of Sint-Niklaas and Aalst use the principle of the concentric expanding compact city (Fig. 3). As a result, blue-green fingers penetrating deep into the urban zone, risk being built-up in the future, separating the citizens from the green rural areas. Moreover, there is a link between those plans and the intrinsic choice for a garden-city-like expansion.




City of Aalst (B) with 78,000 inhabitants.



City of Sint-Niklaas (B) with 68,000 inhabitants.

**Fig. 3.** Official plans for the concentric expansion of the Belgian cities Aalst and Sint-Niklaas. Source: www.ruimtelijkeordening.be

### 3.2 A proposal for a lobe-city Sint-Niklaas and Aalst

Podevyn [20] investigated an alternative model for the city expansion, applying the theoretical lobe-city model on the city of Sint-Niklaas (Fig. 4). This alternative proposed expansion model offers enough urban surface to provide the city with the required industrial areas (125 ha) and residential areas (3406 new dwellings are needed). Podevyn made a plea to mix functions. Within the residential zones, 15 % of the surface is reserved for reconcilable industrial activities[3]. It's an interesting ecological guideline to mix functions, in order to decrease mobility problems. That is also one of the conclusions of Jenks and Dempsey [4], in their search for future forms and design for sustainable cities: all are advocating high-density, mixed use urban quarters such as the French Quarter in Tübingen (Germany, Fig. 1).

Vonck [21] investigated an alternative possibility for the city expansion, applying the theoretical lobe-city model on the city of Aalst (Fig. 6 ; Fig. 7). The alternative proposed expansion model offers enough urban surface to provide the city with the required industrial areas (65 ha) and residential areas (3026 new dwellings are needed). The lobe-city proposal for Aalst provides far more possibilities: 514 ha of residential areas and 128 ha of industrial areas can be found in the designed city lobes.

## 4. DISCUSSION: THE URBAN FRINGE OF A LOBE-CITY

A lobe-city has a very long urban fringe between the built-up lobes and the blue-green fingers. That is opposite to a compact city which has a very short circumference (Table 1 en Table 2)

Further concentric expansion of compact cities leads to unliveable situations such as in the city of Athens (Greece). The rural areas are far away from the centre, the richer citizens try to escape from the centre to the outskirts, closer to the green: social segregation is occurring.

The longer the urban fringe, the better an ecopolis can be achieved. Citizens are rewarded with an attractive neighbourhood: rural and urban qualities both are very close to their dwellings. This strategy leads to the maximum of citizens living in attractive neighbourhoods [22].

Designers of rural areas and urban designers have to meet each other in this urban fringe and have to search together to a mutual adjustment of their (water)plans. Unfortunately the urban fringe is under urban pressure, so it is time scientific attention is given to the design and management of the contact zones between urban and rural

[3] Le congrès international d'architecture moderne (CIAM, 1928-1959) was an international think tank of modernists in architecture and urban planning. Their Athens Charter (1933) put that problems within cities could be resolved by a strict functional segregation and by housing people into huge apartment blocks, scattered in green areas. These ideas were widely adopted by city planners rebuilding Europe after the 2nd world war, although by then, some CIAM planners already doubted about some of the concepts. These old ideas, leading towards huge mobility problems, are rejected nowadays and a lot of cities luckily mix living, working and recreation.

areas [23]. This discourse is developing: e.g. the international congress in Gent (B) which was devoted to the problems of the urban fringe. Also Gieling [ 24 ] makes a plea for redesigning the city fringe (of the lobe-city Amsterdam). Designing gradients carefully offers attractive residential areas but can also carry a huge urban biodiversity.

It's a well known ecological mechanism: gently changing abiotic gradients offer the best conditions for a rich biodiversity (Fig. 5). It was Van Leeuwen [25] who described this very important relationship between pattern (space), process (time) and biodiversity.


**Industrie: 113,0 ha**
**(77,9 + 233,8 * 15%)**

**Wonen: 214,1 ha**
**(15,4 + 233,8 * 85%)**

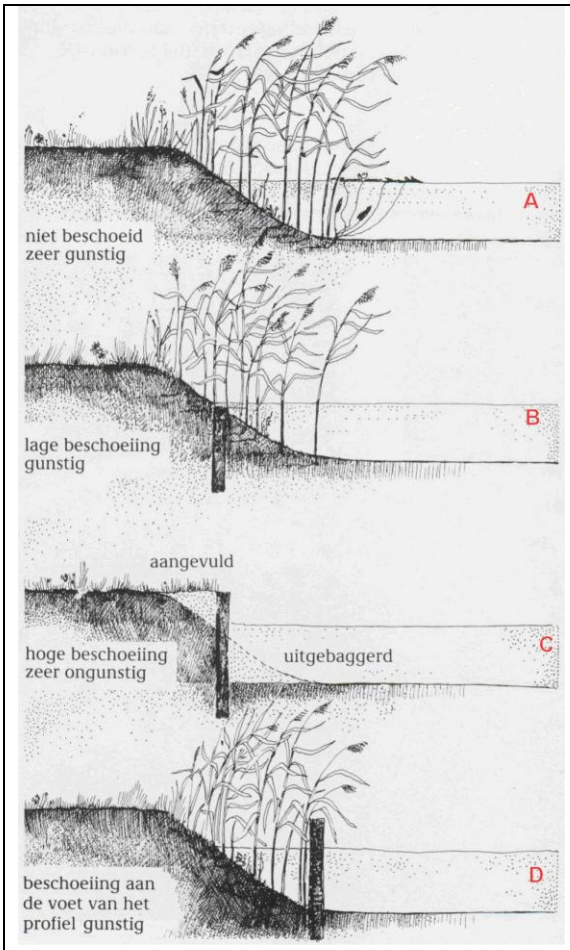
**Fig. 4.** The lobe-city proposal for Sint-Niklaas offers enough industrial (left) and residential (right) areas, even applying the very low obliged densities (compactness) following the Belgian and d Flemish legislation (which requires not more than 25 dwellings/ha for urban zones [20 ,26] ).

**Table 1.** An expansion of the city of Sint-Niklaas applying the lobe-city model results in a longer urban fringe and needs less city surface [20].

| **Sint-Niklaas** | Concentric model | Lobe-city model |
|---|---|---|
| City circumference (urban fringe) | +/- 28,6 km | +/- 44,0 km |
| City surface | +/- 2 537 ha | +/- 1 813 ha |

**Table 2**. An expansion of the city of Aalst applying the lobe-city model results in a longer urban fringe and needs less city surface [21].

| **Aalst** | Concentric model | Lobe-city model |
|---|---|---|
| City circumference (urban fringe) | +/- 44 km | +/- 60 km |
| City surface | +/- 3658 ha | +/- 2412 ha |




Designing slopes very gently, in a gradual manner (A) in stead of making them very steep (C) is better for waterfowl and marsh plants, also within urban areas. If there is a need to protect the riverbanks against damaging (by passing ships) one can choose for solution B or D (permeable bank protection). So breeding zones for all kinds of animals (fish, amphibians, etc.) can be created or conserved in this gently gradient [27].

Culemborg (Netherlands). The designing of a very gently water-land gradient in the urban fringe of the eco-quarter *EVALanxmeer* creates nice living areas for people and appropriate abiotic conditions for different plants and animals. *(Picture by Erik Rombaut)*

Tübingen (Germany). The urban fringe of the city-lobe *French Quarter*. Blue-green fingers are penetrating deep between the city lobes. *(Picture by Erik Rombaut)*

**Fig. 5.** Designing gently gradients in the urban fringe creates conditions for biodiversity and for attractive residential areas.

Table 1 and Table 2 lead to another conclusion. The expansion of both cities, following the lobe-city guidelines, needs fewer surfaces than the concentric expansion model does. These saved areas can be protected from buildings, industry and dwellings. They might be used for the maintenance of biodiversity and for the creation of floodable, wet zones, protecting the inner city against flooding in times of global climate change. An amount of 724 ha for the city of Sint-Niklaas and of 1246 ha for the city of Aalst can be added to the blue-green fingers.

To illustrate that, we confronted the Belgian biological evaluation map of the region around the city of Aalst with the official plans for concentric city expansion (Fig. 6): a lot of areas with a high biodiversity risk getting lost, urbanizing them. In the proposed alternative, following the lobe-city guidelines, those zones are integrated in the proposed blue-green fingers.

Another illustration can be studied in Fig. 7, in which the map with recently flooded areas is confronted with the official plans for concentric city expansion. In the lobe-city expansion model for Aalst, those wet zones (a lot of them situated in the winter bedding of the river ‘Dender’) will be protected from urbanization. They might be part of the blue-green fingers, protecting the inner city from increasing future flooding risks, due to climate change.

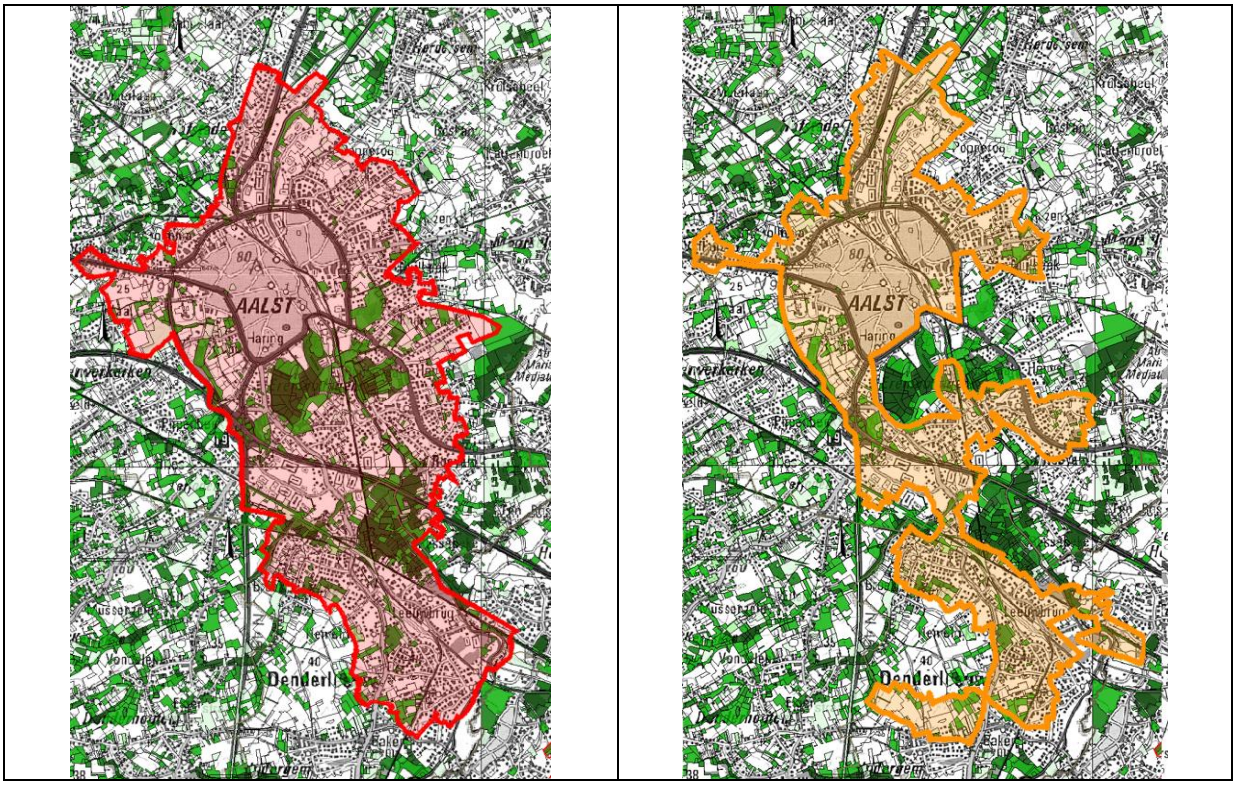



**Fig. 6.** The official proposal to expand Aalst in a concentric way (left) is threatening a lot of areas with a high biological value (green zones). The city expansion following the lobe-city guidelines excludes those green areas from city expansion, integrating them into the blue-green fingers [21] ( www.vlm.be)

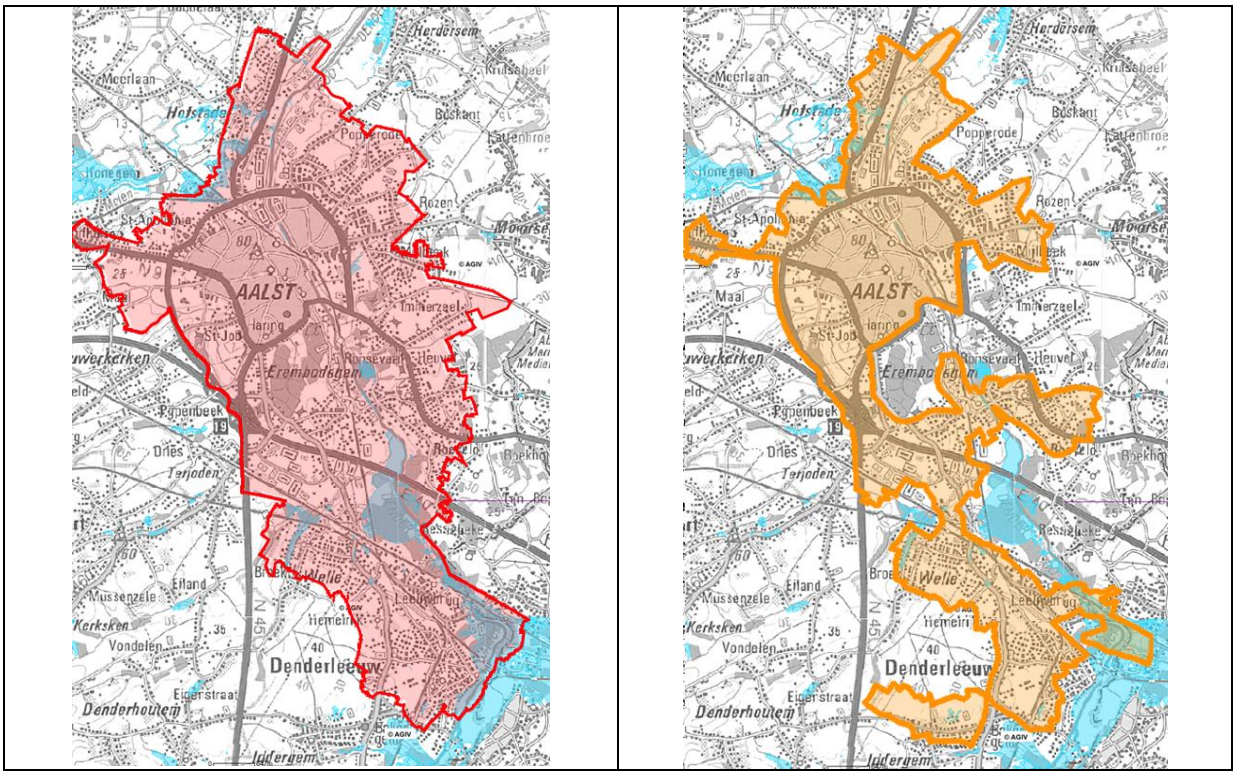



**Fig. 7.** The official proposal to expand Aalst in a concentric way (left) is occupying a lot of recently flooded areas (blue zones). The city expansion following the lobe-city guidelines excludes those wet areas along the river 'Dender' from city expansion, integrating them into the blue-green fingers [21] ( www.vlm.be)

## 5. CLOSING REMARKS: TOWARDS CLIMATE PROOF URBAN DEVELOPMENT

Climate proof urban development will be the challenge of the 21st century [28]. A growing amount of scientific reports gives compelling evidence for the ongoing serious climate changes with effects on rising global temperatures, on precipitation (wetter in wintertime in large parts of northern and western Europe) and on see level rising [29]. In urban regions, the rising global temperatures will be strengthened by the urban heat-island effect. The exceptionally warm and dry European summer of 2003 was responsible for 35,000 extra deaths across Europe as a result of heat stress, bad air quality and high levels of air pollutants such as ozone, especially in urban regions [30]. A lobe-city has better features to mitigate the effects of climate change than a compact city has. Massive blue-green fingers between the built-up compact city lobes provide possibilities for infiltrating rainwater and for storing storm water. This enhances wildlife and biodiversity. By convection from the blue-green wedges, cooler and humid fresh air can enter into the urban zones, cooling them down. That is an adequate tool to temper the city heat island effect.

Our case-study on the Belgian cities of Aalst en Sint-Niklaas made clear that such a lobe-city approach for the expansion of those cities, offers an appropriate alternative for the planned concentric city extension. Regarding these positive results and considering the advantages of a lobe-city approach, we highly recommend a serious investigation of this approach for all planned city extensions. A climate proof lobe-city development will be an advantage for all residents, lucky to live in a lobe-city, but also for biodiversity in urban regions, on a rapidly warming globe.

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